

The use of simulation in the teaching of pathological physiology: basic procedures

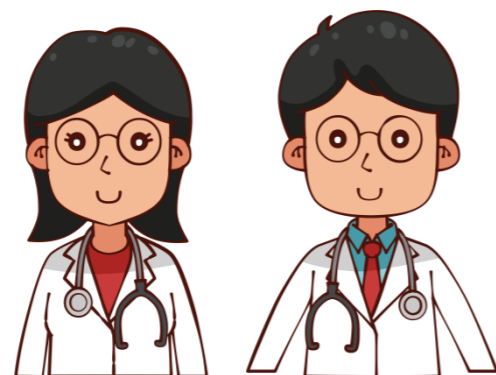
presentation on Moodle

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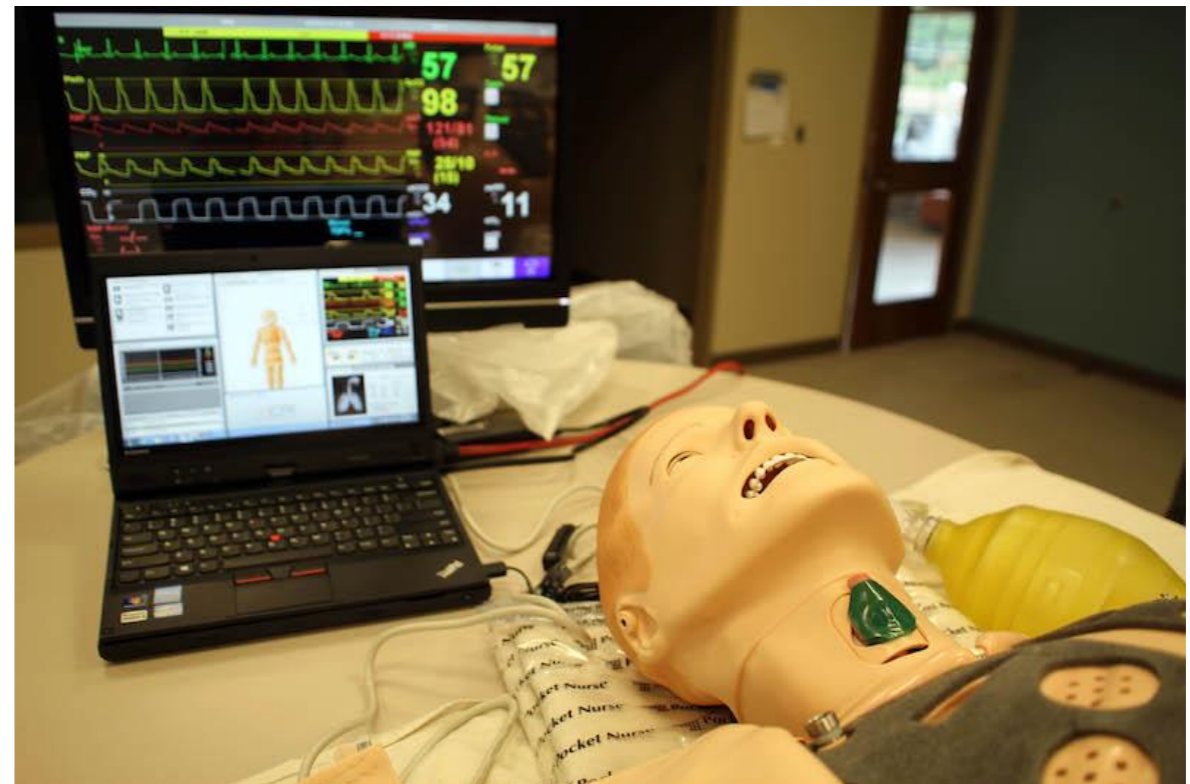
Translation into English:
Capec S., Capec G.

Dear students of pathological physiology!

- Pathophysiology and its teaching methods are developing. One of the possibilities of innovation is the involvement of simulations in practical teaching. We have a department of simulation medicine at LF UP and therefore we decided to use this possibility with the support of the faculty management.
- In the upcoming module, with the help of simulated tasks, you will analyze pathophysiological processes and mechanisms, **discuss with teachers and each other, and you will be able to develop critical thinking** as part of preparing for your future medical profession.
- In this text, we have prepared basic information to help you prepare for this novelty in practical exercises in pathophysiology.



- During the lessons we will simulate various pathophysiological states and events on the Sim Man 3G simulator.
- We hope that the information contained here will be useful to you in study of pathophysiology, and will also help you to gain a basic understanding of simulation medicine, the teaching of which is included in other years of your study. Finally, you will use the acquired knowledge in future work with patients.



Examples of pathophysiological phenomena that we will discuss

kidney failure

**pathological
ECG records**

atherosclerosis

rhabdomyolysis

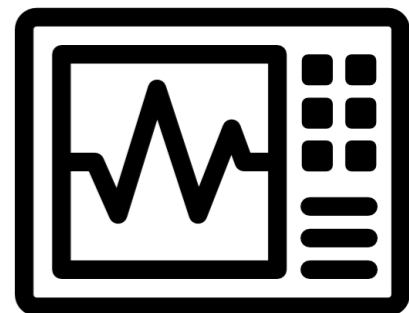
**ion
imbalances**

hypovitaminosis

sepsis

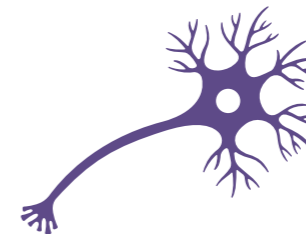
Introduction to simulator function

- To discuss pathophysiology on the simulator, at the beginning of the lesson you will learn about the basic functions of the simulator through CENTESIMO teachers and staff; the teacher will be with you all the time.
- You will be provided with information how exactly the simulator works, what you can investigate, what you need to notice, what to ask.
- You will also become familiar with the basic equipment available to you to monitor vital signs on the simulator.
- It is also necessary to realize that the simulator cannot completely replace the real patient /eg. simulator has constant facial expression, physical examination is limited/ - so it is also important to pay attention to these signs at real patients.



Simulation scenario (“Play”)

- Imagine that you are now a “doctor” and a “patient” is lying in front of you.
- At the beginning the teacher will introduce you to the environment in which you are located (general practitioner's office, urgent reception, inpatient department).
- This is followed by a brief history of the “patient” that will put you in the situation and after which the simulator starts.
- ! the navigated solution of the situation begins!
- The sequence of steps is important.



Sequence

- Pay attention to the initial state and behavior of the simulator (= patient)!

1. Connect sensors for diagnostics /we have available equipment for ECG, blood pressure measurements, saturation, temperature and respiratory monitoring

2. Control

a) consciousness



b) breathing - saturation, AUSCULTATION



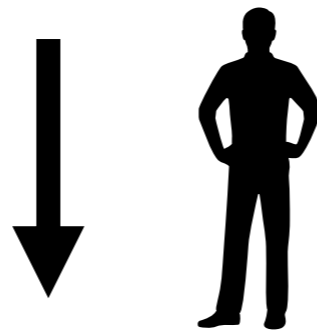
c) circulation - pressure, heart rate, pulse/large blood vessels or peripherals



- ECG - basic curve

3. It is important to focus on physical examination of the patient (see Internal Propaedeutics), which will guide us to further examination -> basic diagnostics

- **Basic diagnostic procedures: visual inspection, auscultation, palpation, percussion, per rectum,**
- we go from head to toes



- During the investigation we ask the patient (teacher/assistant in scenario) questions that can help to clarify the situation /if he/she is able to communicate

4. You may use a laboratory investigation according to your decision

- For example: CBC + differential, coagulation, mineralogram, inflammatory markers, ASTRUP, biochemistry, liver tests, renal function, natriuretic peptides, troponin, urine examination, 24-hour urine collection, metabolites of individual substances in urine
- 12-lead ECG
- it is necessary to realize **what you want to find out** through laboratory and other examinations

5. *Just to add:* you can see the spectrum of auxiliary imaging examinations, which you will learn about later

- ultrasound, X-ray, CT, MR...



6. Together with the teacher students then analyze all the data, including laboratory parameters – it is important to explain the causes of the deviation in different disorders or diseases

7. Students analyze with the teacher the **pathophysiological mechanism** of the condition (with discussion and explanation)

8. The differential diagnosis is important /it does not matter that not everyone will have the same opinion

9. Based on the information available to you, you can try to make a conclusion about diagnosis  /discuss the **PRINCIPLES** of treatment.. 

10. Debriefing of the situation - overall evaluation

Now to the organization



About the organization 1

- The solving of stimulation tasks takes place in the usual practical lessons on the following days
- **Run A** : 18-19. 3. 2020
- **Run B** : 22-23. 4. 2020
- **Course A** - tasks focused on pathophysiology of respiratory and cardiovascular system
- **Course B** - tasks focused on complex, especially acute pathophysiological states in the body

(tasks are always related to disorders of systems of organs, respectively general pathomechanisms which were previously discussed on practical exercises/lectures)

About the organization 2

- This part of practical lessons take place at the study rooms of Center of Telemedicine, Simulators and Practical Skills of the Faculty of Medicine (CENTESIMO)
- It is in your interest to take this course. Unfortunately, substitutions in the 15th week will not be possible due to organizational reasons.

Conditions for passing practical training in pathophysiology on a simulator (run A, B) valid as at 10 March 2020

Department of Pathophysiology provides the following rules for practical training on 18 - 19 March and 22 - 23 April 2020, during the practical lessons with the use of a simulator:

- 1) In these days it is not possible to apply the so-called 10% exception of non-participation in exercises without justification of the absence.
- 2) The student must pass at least 1 run, ie A or B, to be granted credit, the absence must be properly excused. Replacement will be made individually in the 15th week by writing a 3-page protocol on the case and discussing it with the teacher.
- 3) With regard to the interest of the Department to have this form of instruction in both runs attended by a maximum of students, for justified reasons, students may attend the event in these days with another group. The teacher enables it according to the capacity of the groups.

The evolving public health situation may affect both the planned pathophysiology instruction on simulator and the declared conditions of attendance.

Now a practical illustrative example

(“what will actually happen”)



Example of a simulation task on the topic:

ARTERIAL HYPERTENSION

The following illustrative case comes from the e-learning resources of the Department of Pathological Physiology of the Faculty of Medicine and Dentistry Palacky University, we have prepared a number of new tasks for you.

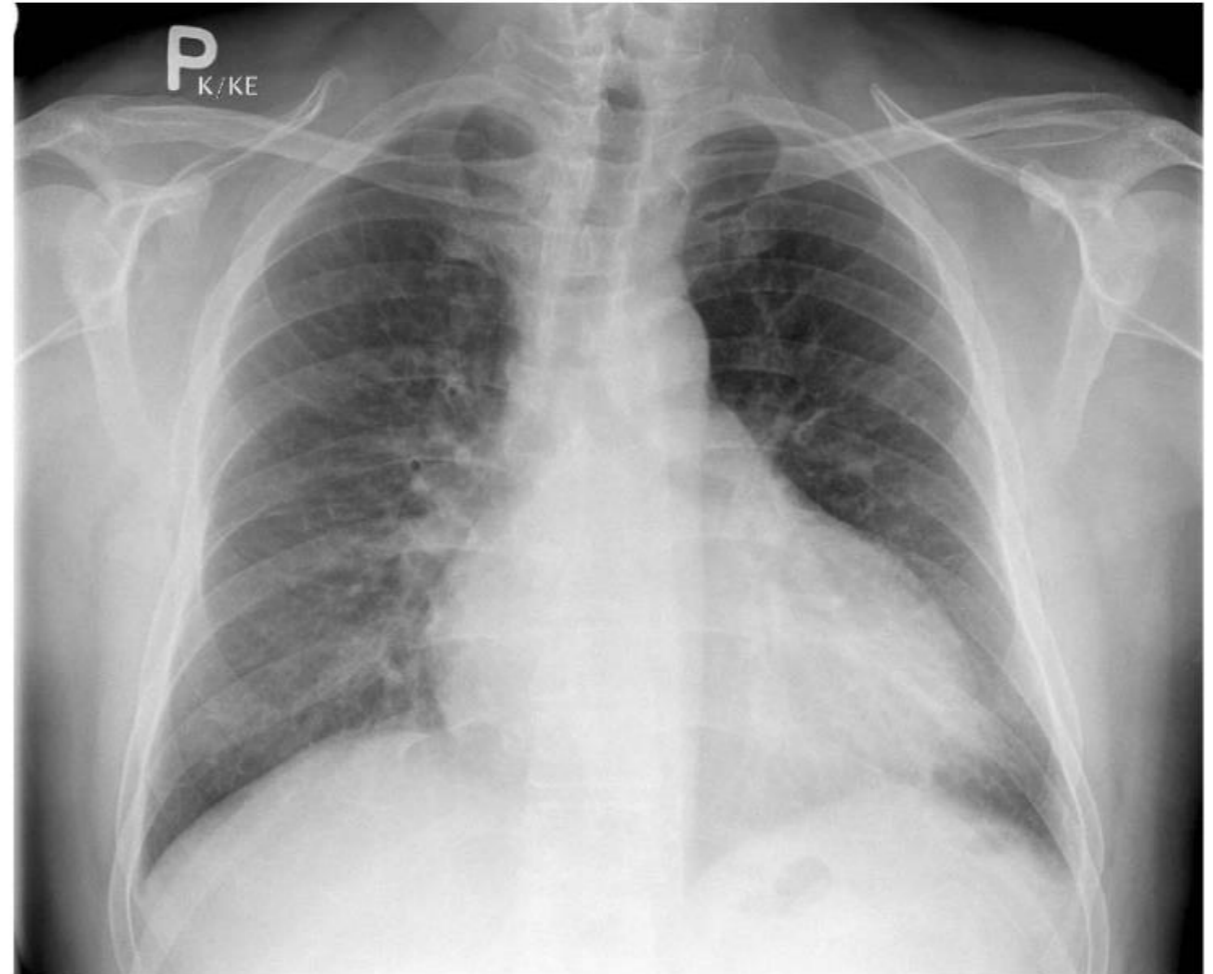
Clinical case report (illustrative example only)

- **Introduction: 64 y.o. patient admitted to hospital for BP 240/140 mm Hg and shortness of breath, chest pain**
- **Monitor after connection: BP: 246/138 HR: 110/min, RR: 20/min, saturation 94%, ECG finding of ST segment elevation in leads V1-4 and inversion of T wave in V5-6 , temperature normal**
- **Medical history: students ask questions about peculiarities**
 - During the last month patient is not feeling well, "uncomfortable", sometimes has a headache. He repeatedly experienced gripping pain behind his sternum, decreasing spontaneously within 5 minutes, without irradiation, without vegetative accompaniment; he felt dyspnea, most at night before admission
 - AH (arterial hypertension) a month ago stopped taking medication
- **Indication: acute coronarography (coronary artery angiography)**
 - negative coronarography, negative angiography of renal arteries
 - depression of systolic LV function with diffuse hypokinesis and ejection fraction 40%
- **Indications: X-ray of heart and lungs, laboratory (what and why) - at reception**

X-ray and income diagnosis (illustrative example only)

Broadening of the heart shadow in both directions, highlighting of the central vascular drawing bilaterally - character of small circulation congestion.

RTG plic vstupní



- **Hypertensive crisis**
 - With acute left-sided heart failure NYHA IV grade
 - Hypertensive cardiomyopathy - EF LV 40%
- The secondary etiology of arterial hypertension should be excluded

How the **pathophysiological debate** can take place

(illustrative example only)

- What pathophysiological mechanism is associated with arterial hypertension and the heart failure?
- What are the most common causes of left and right heart failure?
- How do we diagnose heart failure?
- How does cardiac cardiomyopathy develop in hypertensive disease?
- What are the other consequences of arterial hypertension?
- What does the ECG find?
- What is the mechanism of stenocardia and dyspnea?
- etc.

**Possible examination
scheme and differential
diagnosis of AH**
(illustrative example only)

Arterial hypertension

Basic examination

HISTORY, PHYSICAL EXAMINATION
BLOOD IMAGE, KALIUM, CREATININ, URIC
ACID, GLUCOSE, CHOLESTEROL, HDL,
TRIGLYCERIDES
URINARY WASTE
ECG, chest X-ray
KIDNEY SONOGRAPHY

both clinical
picture and
case history
suggest
**pheochromo
cytoma**

potassium
<3.4mmol / l
Suppression
of renin
**Conn's
syndrome**

examination
indicates
RA stenosis

creatinine,
pathological
finding in
urine,
abnormal
ultrasound of
the kidneys
**kidney
parenchyma
disease**

typical
clinical
finding
**Cushing's
syndrome**

significantly
decreased
BP on lower
limbs, X-ray
finding
**aortic
coarctation**

Laboratory investigations

Biochemistry: Na 134, **K 3,53**, Cl 103 mmol/l

Troponin T 0,09...**0,11**, NT-proBNP **8314** (0-125,0 ng/l)

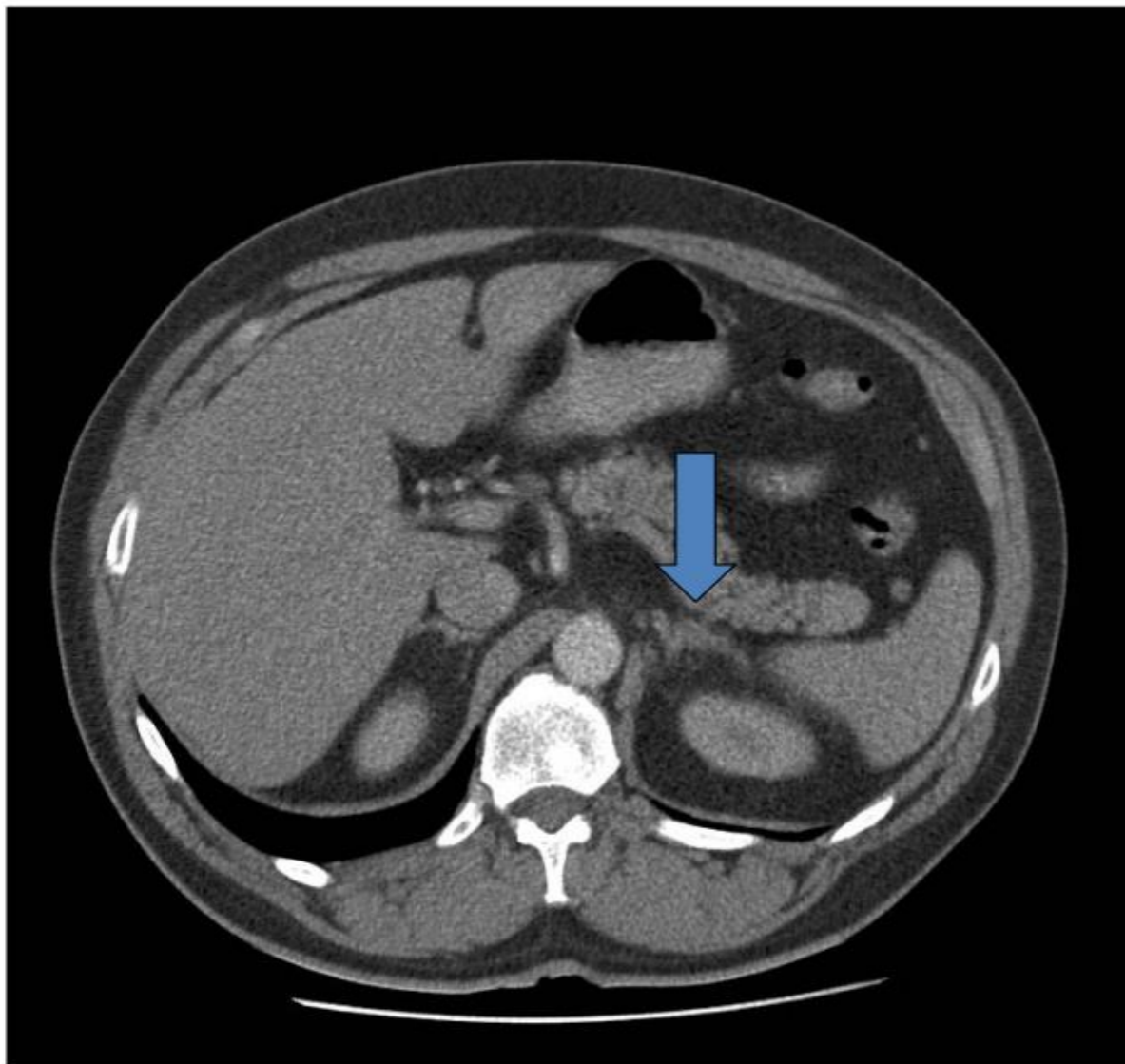
Normal kidney and liver functions, glycaemia, CBC

Cholesterol **5,73**, LDL **3,5**, HDL 1,21 mmol/l

Proteinuria (initial) **1,6 g**/24 hours

After medicaments correction improvement of proteinuria
0,15 g/ 24 hours at the end of hospitalization

?



CT of abdomen

Both suprarenal glands
of appropriate shape
left side: minimal
nodular hyperplasia in
the area of the lateral
arm

In laboratory results: increased
aldosterone 249 ng/l - can
testify to hyperaldosteronism

indication

(illustrative only)

Dear students,

Thank you for your attention and we believe that this innovative form of practical training will be of benefit to you. Looking forward to see you,

Professor M. Petřek